PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Daishi YOSHIKAWA et al.	Group Art Unit: 1745
Application No.: 10/646,686	Examiner: G. CANTELMO
Filed: August 25, 2003	Docket No.: 116925

For: ELECTROLYTE MEMBRANES FOR USE IN FUEL CELLS

DECLARATION UNDER 37 C.F.R. §1.132

I, Daishi Yoshikawa, a citizen of Japan, hereby declare and state:

1. I have a degree in Quantum Engineering and System Science which was conferred upon me by the University of Tokyo in Tokyo in 1998.

2. I have been employed by Noritake Co. Limited since 1998 and I have had a total of nine years of work and research experience in fuel cells.

3. I am a named inventor in the above-captioned patent application.

4. I have a professional relationship with the assignee of the above-identified patent application. In the course of that professional relationship, I received compensation from the assignee for my work relating to fuel cell development. I am not being compensated for my work in connection with this Declaration.

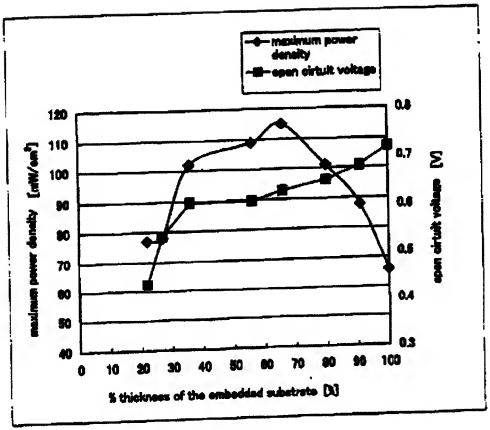
5. I and/or those under my direct supervision and control have conducted the following experiments.

The experimental data includes data demonstrating the relationships between the % thickness of the embedded substrate (the sheet embedded portion) for electrolyte membranes and the maximum power density (MPD) and the open circuit voltage (OCV). The materials used to form the electrolyte membranes for the experimental data include Nafion® Solution

and glass cloth of various thickness (plain-weaved glass yarn) in accordance with paragraph [0032] of the present specification. The samples of the electrolyte membranes were prepared by casting, followed by sheet placement, followed by another casting in accordance with paragraph [0033] of the present specification. Cell preparation and measurements were carried out as described in the present specification using the same fuel solution and cathode gas at the same cell temperature of 95 °C to obtain the MPD and OCV measurements for the samples in accordance with paragraphs [0036]-[0039] of the present specification.

The relationships between the % thickness of the embedded substrate (the sheet embedded portion) for electrolyte membranes and the MPD and the OCV obtained from the experimental data are set forth in the following Table and Graph.

the thickness of the substrate [μm]	the entire thickness of the electrolyte membrane [μm]	% thickness of the embedded substrate [%]	maximum power density [mW/cm²]	open circuit voltage [V]
80	81	100	86	0.72
78	86	91	88	0.86
84	90	80	101	0.85
54	82	66	115	0.83
47	84	56	109	0.81
29	79	36	102	0.81
22	80	27	78	0.54
18	82	22	77	0.44



The Table illustrates the relationships between (1) the thickness of the substrate (see column 1), (2) the entire thickness of the membrane (see column 2), (3) the % thickness of the embedded substrate (see column 3), (4) the MPD (see column 4), and (5) the OCV (see column 5).

The Graph illustrates the relationships between (1) the % thickness of the embedded substrate (see x-axis), (2) the MPD (see left y-axis), and (3) the OCV (see right y-axis).

Maximum Power Density (MPD)

The Table and Graph demonstrate that when the % thickness of the embedded substrate is greater than 80%, the proton conductivity becomes lower and the MPD of the electrolyte membrane decreases significantly. For example, when the % thickness of the embedded substrate is 80%, the MPD for the electrolyte membrane is 101 mW/cm^2 which is superior when compared to an MPD of 88 mW/cm^2 for an electrolyte membrane having a % thickness of the embedded substrate of 91%.

Additionally, the Table and Graph of the Declaration demonstrate that when the % thickness of the embedded substrate is less than 30%, the MPD for the electrolyte membrane decreases significantly due to methanol crossover. For example, when the % thickness of the embedded substrate is 36%, the MPD is 102 mW/cm^2, which is superior when compared to an MPD of 78 mW/cm^2 for an electrolyte membrane having a % thickness of the embedded substrate of 27%.

Thus, the Table and Graph of the Declaration demonstrate that the MPD for an electrolyte membrane having a thickness of a portion of a matrix that has the sheet embedded therein within a range between 30% and 80% of the entire thickness of the matrix is superior when compared to the MPD for electrolyte membranes having a thickness outside of the range between 30% and 80%, such as 91% and 27%.

Open Circuit Voltage (OCV)

The Table and Graph also demonstrate that when the % thickness of the embedded substrate is (1) 30% or greater, inhibition of methanol crossover significantly increases and thus OCV is higher, and (2) less than 30%, inhibition of the methanol crossover is insufficient and thus OCV is lower. For example, when the % thickness of the embedded substrate is 36%, the OCV for the electrolyte membrane is 0.61 V which is superior when compared to an OCV of 0.54 V for an electrolyte membrane having a % thickness of the embedded substrate of 27%.

Moreover, the Table and Graph of the Declaration demonstrate that the OCV for an electrolyte membrane having a thickness of a portion of a matrix that has the sheet embedded therein greater than 30% of the entire thickness of the matrix is superior when compared to OCVs for electrolyte membranes having a thickness less than 30% of the entire thickness of the matrix, such as 27%.

Thus, the results of the experimental data as set forth in the Table and Graph demonstrate that an electrolyte membrane having a thickness of a portion of a matrix that has the sheet embedded therein within a range between 30% and 80% of the entire thickness of the matrix is critical to producing an electrolyte membrane having excellent conductivity and superior maximum power density and open circuit voltage when compared to electolyte membranes that do not have a % thickness of the embedded substrate within the required range between 30% and 80% of the entire thickness of the matrix as recited in claim 17 of the present application.

6. I hereby declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine and/or imprisonment under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing therefrom.

Date: October 1, 2009

吉川大士

Daishi Yoshikawa